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(54) A construction for automatically milking animals.

(57) The invention relates to a construction for automatically milking animals, such as cows, provided with a milking robot (14). The construction comprises a shed (1) or any other space where the animals are

allowed to move freely. The shed (1) or other space is designed such that the milking robot (14) moves to an animal to be milked and performs the milking on the spot.

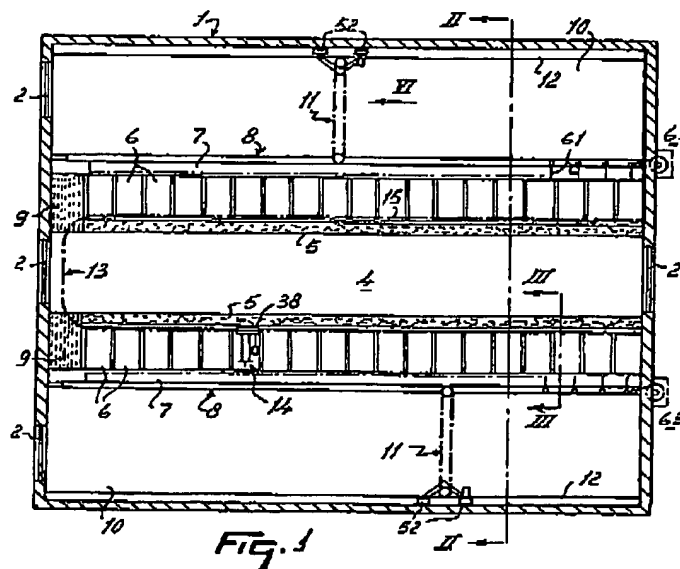


Fig. 1

Rank Xerox (UK) Business Services
(3.10/3.09/3.5.4)

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The present invention relates to a construction for automatically milking animals, such as cows, provided with a milking robot.

Such constructions are known.

In such a construction, the animals are allowed to move about freely, while the animals will go to the milking robot in order to be automatically milked. This milking may cause delay.

It is an objective of the invention to obviate these drawbacks. Therefore, the construction according to the invention comprises a shed or any other space where the animals are allowed to move about freely and which is constructed in such a way that the milking robot can move to an animal to be milked and milks the animal on the spot. This offers the advantage of a greater certainty that a given animal will be milked at a particular time, because the milking robot moves to the relevant animal.

The invention also relates to a construction, comprising a milking robot, for automatically milking animals such as cows, characterized in that this construction comprises a computer and process control system, through which the milking robot is automatically moved to an animal to be milked.

According to another feature of the invention, the computer system decides which cow is to be milked. According to still another feature of the invention, the construction comprises a number of compartments designed as resting boxes which are also suitable to serve as milking parlours and/or feeding places.

According to another feature of the invention, the construction comprises a transmitter and a receiver, by means of which the presence of a cow in a resting box can be detected. Whether an animal is present in a resting box can be recorded by means of the computer system and transponders provided on the animals' necks, according to a further feature of the invention. With the computer system it is also feasible to identify which animal is in which resting box. According to yet another feature of the invention, the computer system is also capable of determining whether a particular animal has not been milked in a longer time period than other animals. Accordingly, the invention also relates to a construction for automatically milking animals, such as cows, comprising a milking robot, characterized in that the construction comprises a computer system, through which the milking robot is capable of automatically moving to an animal to be milked which has not been milked for a longer period of time than an other animal. For example, it may be found that a given cow has not been milked for the last eight hours, upon which the computer system causes the milking robot to move automatically to this cow and to milk her.

To allure the animals to the resting boxes, the construction according to the invention comprises a concentrates dispensing device, through which the animals are individually given concentrates, while there are also provided signalling means, through which the attention of an animal is drawn to the supply of concentrates. Accordingly, the invention also relates to a construction for automatically milking animals, such as cows, comprising a milking robot, characterized in that the construction comprises a concentrates dispensing device, through which the animals can be individually given concentrates, while there are also provided signalling means which serve to draw the attention of an animal to the supply of concentrates.

To elucidate the invention, an exemplary embodiment of the invention will now be further explained with reference to the accompanying drawings, in which:

Figure 1 is a plan view of a shed comprising two rows of resting boxes;

Figure 2 is a cross-section of the shed taken along the line II-II in Figure 1, where each row of resting boxes is provided with a milking robot and a concentrates dispensing system;

Figure 3 is a cross-sectional view of a resting box and a milking robot taken along the line III-III in Figure 1;

Figure 4 is a rear view of the resting box, as indicated by the arrow IV in Figure 3;

Figure 5 shows a plan view of a plurality of resting boxes, as indicated by the arrow V in Figure 3;

Figure 6 is a side view of a cross conveyor for the removal of manure, as indicated by the arrow VI in Figure 1;

Figure 7 is a plan view of the cross conveyor for the removal of manure, as indicated by the arrow VII in Figure 6 and

Figure 8 shows enlarged a longitudinal conveyor for the removal of manure in the manure channel of Figure 1.

In Figure 1, the plan view shows a shed 1 provided with doors 2 and a floor 3. A feeding passage 4 with, on either side, a long feed trough 5 (Figure 2) extending over the full shed length is centrally arranged in the cow shed 1. On either side of the feeding passage 4 there is provided a row of resting boxes which may be used as places for the animals to rest, to be milked and to be fed. As is shown in Figures 1 and 2, at the rear side of each row of resting boxes 6 there is provided a manure channel 7 equipped with a conveyor 8 capable of removing unidirectionally the manure present in the manure channel 7. On one end of each row of resting boxes 6 is a receptacle 9 to store the manure removed by the longitudinal conveyor 8. The receptacle 9 has a connection with a

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manure storage pit - not shown. Behind each row of resting boxes there is also a loafing passage 10, on which the animals are allowed to move about freely. The floor 3 of the loafing passages 10 and the resting boxes 6 are inclined slightly downward in the direction of the manure channels 7. The angle of inclination of the floor 3 is preferably 1 to 2°. The floor is treated with a coating which prevents ammonia or ammonia-containing substances from penetrating into the floor 3.

Arranged transversely to each loafing passage 10, a cross conveyor 11 is to remove any manure and/or urine from the loafing passage 10 into the manure channel 7. The cross conveyor 11 is capable of travelling to and fro in the longitudinal direction of the shed 1 on a rail 12 installed near either outer wall of the shed 1.

In the shed 1, there is also provided a U-shaped robot line 13, along which a milking robot 14 is movable. The legs of the U-shaped robot line 13 extend along the front side of the resting boxes 6. As is indicated in Figure 2, the robot line 13 comprises a beam 15 fastened to the roof truss 17 of the shed 1 by means of supports 16. The beam 15 is suspended about two metres from the floor 3. Furthermore, near the front of each resting box 6, there is provided a concentrates feeding system 18, through which the animals having taken their places in resting boxes 6 can be individually given concentrates, such as pellets. The concentrates feeding system 18 comprises for each resting box a feed trough 19 arranged on a "periscope-like" telescoping tube 20. The telescoping tubes 20 are attached to the roof truss 17 and connected to a supply line 21 for the supply of concentrated-feed pellets from a storage room - not shown. The "periscope-like" telescoping tube 20 is capable of moving each feed trough vertically and of pivoting each feed trough 19 on a vertical shaft. For depositing roughage in the long feed troughs 5, e.g. by means of a silage waggon 22, the feed troughs may be temporarily raised, so as that not to interfere with the supply of roughage into the long feed troughs 5.

Figures 3 - 5 show in detail in which way the milking robot 14 milks the cows in the resting box(es) 6. Each resting box 6 comprises a rectangular tubular frame 23, which constitutes the front of a resting box 6. Two vertical tubes 24 are arranged at a certain distance from each other near the centre of the tubular frame 23 in such a way that the interspace allows the head of an animal to reach a long feed trough 5 and a feed trough 19. Each resting box 6 also comprises two U-shaped side walls 25 which connect with the posts 26 of the tubular frame 23. Near the end, a second U-shaped frame 27 mounted on one of the U-shaped side walls 25 of a resting box 6 by means of two

horizontal connecting rods 28, is disposed at a certain distance from and parallel to the U-shaped side wall 25. The second U-shaped frame 27 extends from the rear side of the resting box 6 to approximately halfway the resting box 6. In the space 29 (Figure 5) thus created by the parallel frames 25 and 27, the milking robot 14 is allowed to swivel in a vertical plane, without causing there any trouble to an animal which has taken its place in a relevant resting box 6. As is reflected in Figure 3, the milking robot 14 comprises a robot arm 30 having on its end a robot head 31 equipped with teat cups 32. In addition, the robot head 31 comprises a detection sensor 33 which enables to determine e.g. the positions of the teats of an animal to be milked. The robot head 31 is capable of being moved in a horizontal plane by means of a first quadrangular hinge mechanism 34, one end of which is connected to the robot arm 30 and the other end to a supporting plate 35. Furthermore, the supporting plate 35 is provided with two lugs 36 connected with the arms of a second quadrangular hinge mechanism 37. The other end of the second quadrangular hinge mechanism 37 is connected with a U-shaped sleeve 38 slidable on the beam 15 of the robot line 13. The milking robot 14 can swivel in a vertical plane by means of the second quadrangular hinge mechanism 37, so that in the event that the milking robot 14 is moved along the beam 14 to a certain resting box 6, the milking robot 14 is capable of being swivelled upwards by means of the quadrangular hinge mechanism 37, as is indicated by dashed lines 39 in Figure 3. When the relevant resting box 6 has been reached, the milking robot 14 can be swivelled in the space 29 of a milking box 6 by means of the second quadrangular hinge mechanism 37, whereupon the robot head 31 can be swivelled, by means of the first quadrangular hinge mechanism, to a position under the udder of an animal to be milked. The positions of the teats are determined by means of the detection sensor 33, whereupon the teat cups are automatically connected to the teats of the animal concerned.

On the sleeve 38, next to the milking robot 14, there is provided a positioning construction 40, by means of which an animal in a resting box 6 is restricted in its freedom of motion both in rearward and in sideward direction. The positioning construction 40 comprises two arms 41 which are disposed on the sleeve 38, rotatably mounted on a horizontal shaft 42. The two arms 41 are at a certain distance from each other and their ends are interconnected by an arc-shaped brace 43 which, in a rear view of a resting box 6, extends transversely to the longitudinal direction of the resting box 6. The arc-shaped brace 43 has a diameter which roughly corresponds with the width of a full-grown cow. Near the

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centre of the arc-shaped brace 43, a bent tube 44 extending obliquely rearwards and downwards in the longitudinal direction of the resting box 8 is provided and, when the cow has been positioned, is in contact with the rear part of the animal. The brace 43 and the tube 44 thus constitute a tripod positioning construction which is pivotable in a vertical plane on the horizontal shafts 42. During the milking robot 14 motion along the robot line 13, both the milking robot 14 and the positioning construction 40 are swung up.

The operation of the above-described construction will be explained below.

Every animal present in the shed 1 is provided with a collar 45 bearing a transmitter 46, by means of which transmitter the identity of the relevant cow can be transmitted to a computer - not shown - provided with a cow recognition system. Through the computer it is recorded which animal has been milked at a certain time by means of the milking robot 14 and how much time has lapsed since then. On the basis of the time elapsed since a milking, the computer can determine which animal in the herd was milked the longest time ago. If the relevant animal is in or near a resting box 6, it will be attempted to milk the animal by means of the milking robot 14. In the event that the relevant animal is in a resting box 6, the milking robot 14 is moved along the robot line 13 to the respective resting box 6, and the animal is limited in its freedom of motion in the resting box by means of the tripod positioning construction 40. At the same time or subsequently, the feed trough 19 arranged near the front of the relevant resting box 6 is turned to the animal (Figure 5) and the animal is given a predetermined amount of concentrated feed by the concentrates dispensing system. Subsequently, the milking robot 14 is swung down from the raised position and the milking robot head 31 is moved to underneath the animal, whereupon the teat cups 32 can be connected to the teats. Subsequently, automatic milking can start, while the teat cups are disconnected on completion of the milking and the milking robot 14 is again put into the raised position then. Subsequently, the positioning construction 40 is also swung up and the feed trough 19 is turned away from the animal. After this, the milking robot 14 can be moved along the robot line to another animal to be milked.

If the animal is not in a position appropriate for milking in a resting box 6 - which means that the animal, for instance, lies in the resting box 8 or is in the vicinity of the resting box 8 -, then the feed trough 19 is put into position by means of the concentrates dispensing system 18 and concentrated feed is thrown into the feed trough 19. Because the throwing of concentrates into the feed trough 19 is accompanied by noise, this will usually

be noticed by the animal, whereupon the animal will get up and go to the feed trough 19 where the animal can subsequently be milked. If an animal remains lying in the resting box 8 after concentrated feed has been supplied through the concentrates dispensing system 18, the animal can be stimulated to get up by touching the animal with the positioning construction 40.

In the Figures 6 and 7, the cross conveyor 11 of Figure 1 is shown enlarged and more detailed. The cross conveyor 11 covers the full width of the loafing area in the cow-shed 1, while one end of the cross conveyor 11 projects above the manure channel 7. The cross conveyor 11 comprises a looped chain 47 which is mounted on gearwheels 48 at the two ends of the cross conveyor 11 (Figure 7). The two gearwheels 48 are interconnected by an intermediate beam 49, of which one end is connected with a V-shaped frame 50. The two legs of the V-shaped frame 50 are interconnected by a horizontal U-shaped strip 51, whose both ends are provided with roller pair members 52, by means of which the cross conveyor 11 can be moved to and fro along the rail 12 in the longitudinal direction of the shed 1. For this purpose, one roller member 52 is driven by a motor 53, which is an electric motor in the exemplary embodiment of the invention. The chain 47 has on its bottom side bristles 54 which bear on the floor 3 of the loafing area in the shed 1. Through the gearwheel 48 situated near the V-shaped frame 50, the chain 47 is driven by a second motor 55 which is also in the form of an electric motor.

If the cross conveyor 11 is moved in the direction indicated by arrow 56 in Figure 7, the second electric motor 55 drives the chain 47 counter-clockwise, so that the manure and/or other dirt present on the floor 3 of the loafing area in the shed 1 is carried off in the direction of the manure channel 7. When the cross conveyor has reached the end of the shed 1, the electric motor 53 is automatically changed over, so that the cross conveyor 11 moves in the opposite direction, as is indicated by arrow 57 in Figure 7. The first electric motor 53 is simultaneously changed over, so that the chain 47, too, is turned clockwise instead of counter-clockwise, so that also in the event that the cross conveyor 11 is moved in the direction of arrow 57 the manure is carried into the manure channel 7.

In Figure 8, the longitudinal conveyor 8 of Figure 1 is shown enlarged and more detailed. The longitudinal conveyor 8 comprises a U-shaped frame beam 58 slidably mounted on a rail 59 which is placed on the bottom of the U-shaped manure channel 7 and extends along a side wall of this manure channel 7. On the U-shaped frame beam 58 and at a certain mutual distance there are provided two upright shafts 60 with bearing-mount-

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ted rotatable carriers 61 around them. On one side, the carriers 61 are provided with a stop 62 which can bear on the side of the U-shaped frame beam 58. In the exemplary embodiment of the invention, the carriers are made of steel and on their bottom side they are provided with a rubber strip bearing on the bottom of the manure channel 7. It will be obvious that the carriers 61 may also be completely made of plastic or metal or any other type of material.

Arranged near an end of the U-shaped beam 58 there is an eccentric drive 63, by means of which the U-shaped frame beam 58 can be moved to and fro on the rail 59. The eccentric drive 63 comprises an electric motor 64 attached to the outer wall of the shed 1 by means of a support 65. An arm 67 with an upright shaft 68 on its end is arranged on the drive shaft 66 of the electric motor 64. A pivotable drag link 69 embracing the upright shaft 68 is pivotably connected with an upright shaft 70 fitted on the U-shaped frame beam 58.

The operation of the longitudinal conveyor 8 is as follows:

When the electric motor 64 is energized, the eccentric drive 63 moves the U-shaped frame beam 58 to and fro along the rail 59 in the direction of the arrows 71 and 72 in Figure 8. When the U-shaped frame beam 58 is moved in the direction of the arrow 71, the carriers 61 will bear on the U-shaped frame beam 58 through the stops 62, and any manure and/or other dirt present in front of the carriers 61 is removed in the direction of the arrow 71. When the direction of motion by the U-shaped frame beam 58 is reversed and is in the direction of the arrow 72, the friction between the bottom of the manure channel 7 and the carriers 61 will cause the carriers 61 to rotate on the shaft 60 until the instant that they come to bear on the U-shaped frame beam 58. It will be obvious that the carriers 61 do not displace any manure when the U-shaped frame beam 58 moves in the direction of the arrow 72 in Figure 8. Because the U-shaped frame beam 58 is then moved again in the direction of the arrow 71, the carriers 61 rotate and come again to bear on the U-shaped frame beam 58 through the stops 62, whereupon manure or other dirt is again pushed up in the direction of the arrow 71. In this way, the manure and/or dirt is stepwise driven up in one direction, towards the end of the manure channel 7, where it is caught in a receptacle 9 for subsequent transportation, for instance, to a manure storage space outside the shed.

The invention is not limited to what has been described hereinbefore, but it also extends to what is reflected in the drawings.

Claims

1. A construction for automatically milking animals, such as cows, provided with a milking robot (14), characterized in that the construction comprises a shed (1) or any other space where the animals are allowed to move about freely and which is constructed in such a way that the milking robot (14) can move to an animal to be milked and milks the animal on the spot.
2. A construction according to claim 1, characterized in that it comprises a computer and process control system, through which the milking robot (14) is automatically moved to an animal to be milked.
3. A construction for automatically milking animals, such as cows, provided with a milking robot (14), characterized in that the construction comprises a computer and process control system, through which the milking robot (14) is automatically moved to an animal to be milked.
4. A construction according to any one of claims 1 to 3, characterized in that it comprises a computer system, through which the milking robot (14) is capable of moving automatically to an animal which has not been milked for a longer period of time than the other animals.
5. A construction for automatically milking animals, such as cows, provided with a milking robot (14), characterized in that the construction comprises a computer system, by means of which the milking robot (14) is capable of moving automatically to an animal which has not been milked for a longer period of time than an other animal.
6. A construction according to claim 4 or 5, characterized in that the computer system decides which cow is to be milked.
7. A construction according to any one of the preceding claims, characterized in that it comprises a transmitter (46) and receiver suitable for detecting the presence of a cow in a resting box (6).
8. A construction according to claim 7, characterized in that the transmitter (46) is mounted on a collar for attachment to an animal.
9. A construction according to any one of the preceding claims, characterized in that it comprises a number of compartments designed as

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resting boxes (6) which are also suitable to serve as milking parlours.

10. A construction according to claim 9, characterized in that the resting box (8) is provided with means (5) suitable for the supply of feeds to the animal.
11. A construction according to claim 10, characterized in that the said means comprise a feed trough (5) disposed to the floor.
12. A construction according to any one of the preceding claims, characterized in that it comprises a concentrates dispensing system (18), through which the animals can be individually given concentrates, while there are also provided signalling means which serve to draw the attention of an animal to the supply of concentrates.
13. A construction for automatically milking animals, such as cows, provided with a milking robot (14), characterized in that the construction comprises a concentrates dispensing system (18), through which the animals can be individually given concentrates, while there are also provided signalling means which serve to draw the attention of an animal to the supply of concentrates.
14. A construction according to claim 12 or 13, characterized in that the concentrates dispensing system (18) comprises a feed trough (19).
15. A construction according to any one of the preceding claims, characterized in that it comprises a detection device suitable for deciding whether the animal is standing or lying.
16. A construction according to any one of the preceding claims, characterized in that it comprises a device suitable for stimulating automatically the animal-to-be-milked to get up.
17. A construction according to any one of the preceding claims, characterized in that it comprises a positioning construction (40) which obstructs rearward and sideward movements of the animal.
18. A construction according to claim 17, characterized in that the positioning construction (40) is pivotable in a vertical plane.
19. A construction according to claim 18, characterized in that the positioning construction (40) comprises a tripod limiting device (43,

44).

20. A construction according to any one of the preceding claims, characterized in that the computer system controls the milking robot (14) such that the construction is capable of milking e.g. five animals disposed side by side as well as five animals disposed at random distances from each other.
21. A construction according to any one of the preceding claims, characterized in that the milking robot (14) is transportably arranged within a herd and is capable of automatically milking an animal at the option of the computer system.
22. A construction according to any one of the preceding claims, characterized in that the milking robot (14) is movable along a robot line (13) provided in the shed (1).
23. A construction according to claim 22, characterized in that the robot line (13) comprises a beam (15) mounted above and near the front of the resting boxes (6).
24. A construction according to any one of claims 21 to 23, characterized in that the robot arm (30) is attached to the beam (15) in such a way that, with respect to the beam (15), it is movable both in a horizontal plane and in a vertical plane.
25. A construction according to claim 24, characterized in that the robot arm (30) comprises a robot head (31) equipped with teat cups (32) and also comprises a sensor (33) which enables to determine the positions of the teats of an animal to be milked.
26. A construction according to any one of the preceding claims, characterized in that the resting box (8) comprises tubular side walls (25, 27) and also a tubular front wall (20) which is placed near a feed trough (19).
27. A construction according to claim 25, characterized in that the milking robot (14) comprises a first quadrangular hinge mechanism (34) which enables the robot head (31) to be moved in a horizontal plane, and a second quadrangular hinge mechanism (37) which enables the robot head (31) to be moved in a vertical plane.
28. A construction according to any one of the preceding claims, characterized in that the

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resting box (6) comprises a first space in which an animal is allowed to take its place, and a second space (29) which is inaccessible to the animal, with the milking robot (14) being movable in a vertical plane along the latter space.

29. A construction according to claim 28, characterized in that the second space (29) is bounded by one side wall (25) of the resting box (6) and a further partition (27) wall which at least partly extends in the longitudinal direction of the resting box (6).

30. A construction according to any one of the preceding claims, characterized in that in the longitudinal direction of the shed (1) two rows of resting boxes (6) are provided, with these rows being at a certain distance from each other and having a feeding passage (4) in between them.

31. A construction according to claim 30, characterized in that the two rows of resting boxes (6) are approachable by at least one milking robot (14).

32. A construction according to any one of the preceding claims, characterized in that at least one milking robot (14) is available for each row of resting boxes (6).

33. A construction according to any one of the preceding claims, characterized in that it comprises a manure channel (7) for manure removal.

34. A construction according to claim 33, characterized in that the manure channel (7) for manure removal is provided near the rear side of the resting boxes (6).

35. A construction according to any one of the preceding claims, characterized in that on the floor of the shed (1) there is provided a cross conveyor (11) which serves to carry off the manure to the manure channel (7).

36. A construction according to any one of the preceding claims, characterized in that in the manure channel (7) there is provided a longitudinal conveyor (8) which carries off the manure in one direction.

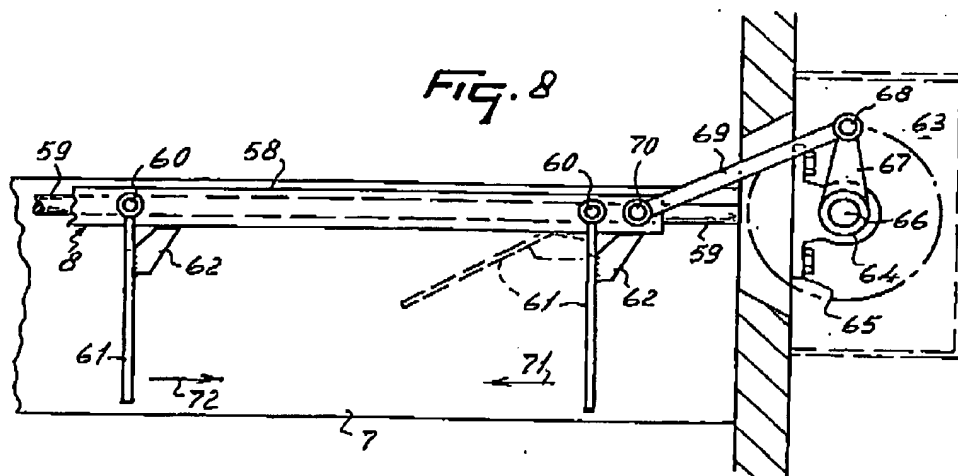
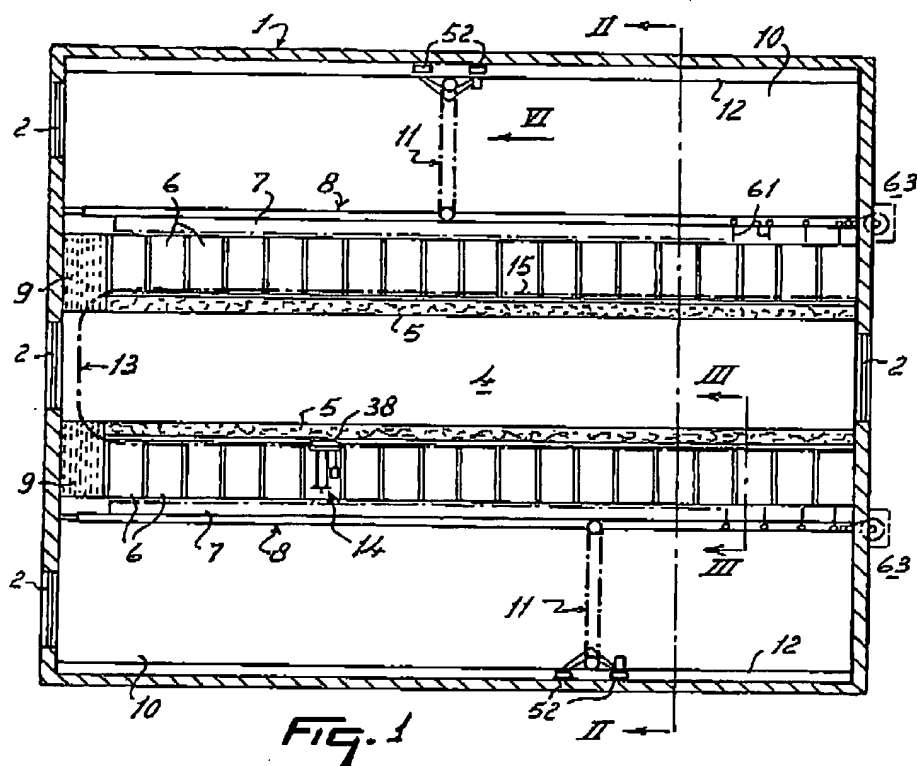
37. A construction according to any one of the preceding claims, characterized in that the moving parts of the construction are controlled by pneumatic or electric drives.

38. A construction according to any one of the preceding claims, characterized in that every resting box (6) is provided with a concentrates dispensing system (18) including a feed trough (19) movable in height and pivotable on a virtually vertical shaft.

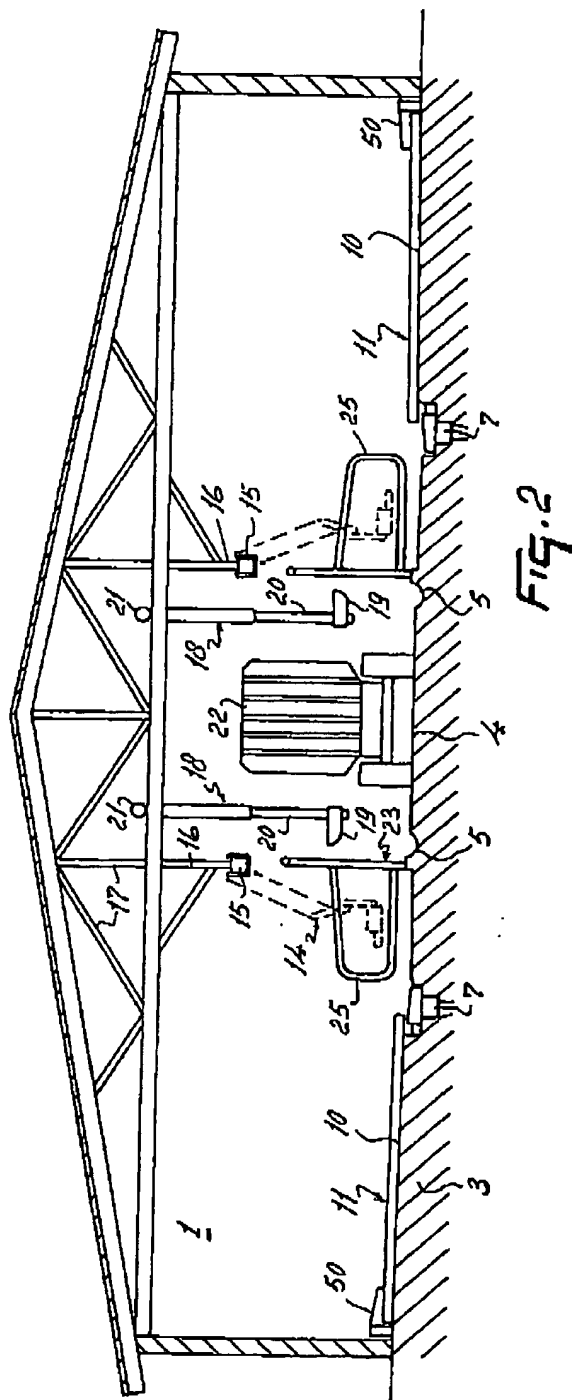
39. A construction for automatically milking animals, such as cows, provided with a milking robot (14), characterized in that every resting box (6) is provided with a concentrates dispensing system (18) including a feed trough (19) movable in height and pivotable on a virtually vertical shaft.

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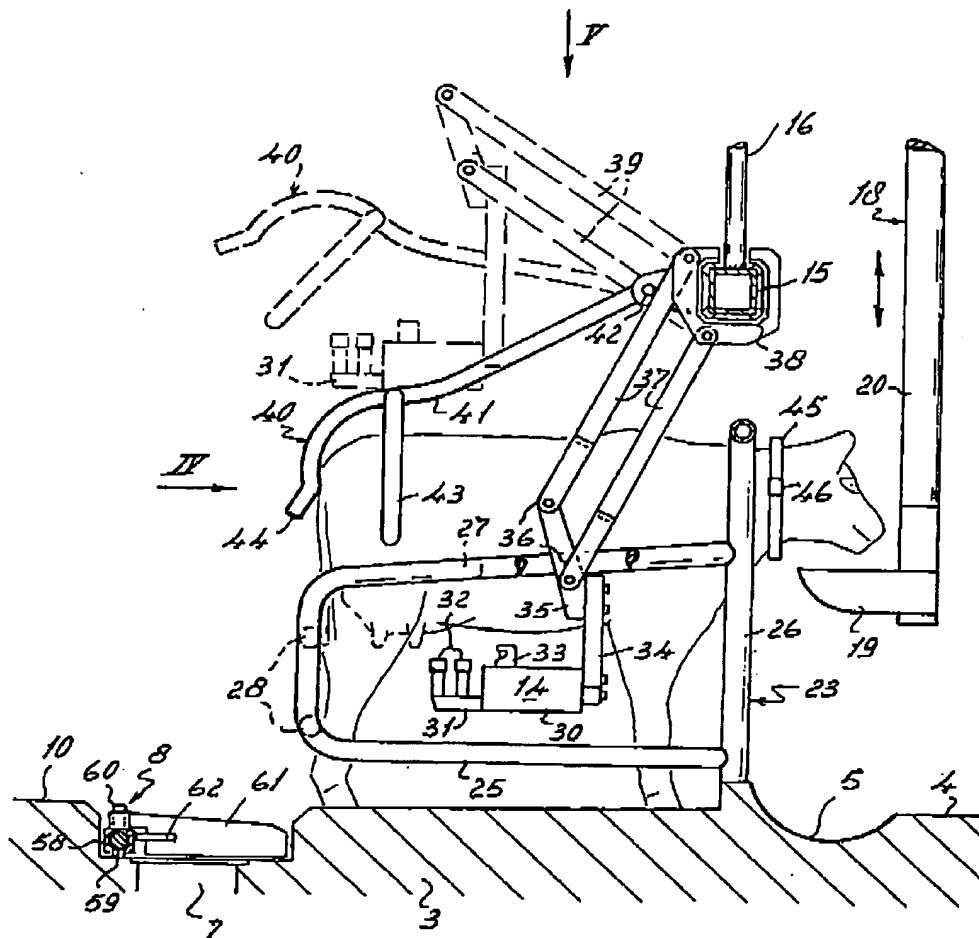
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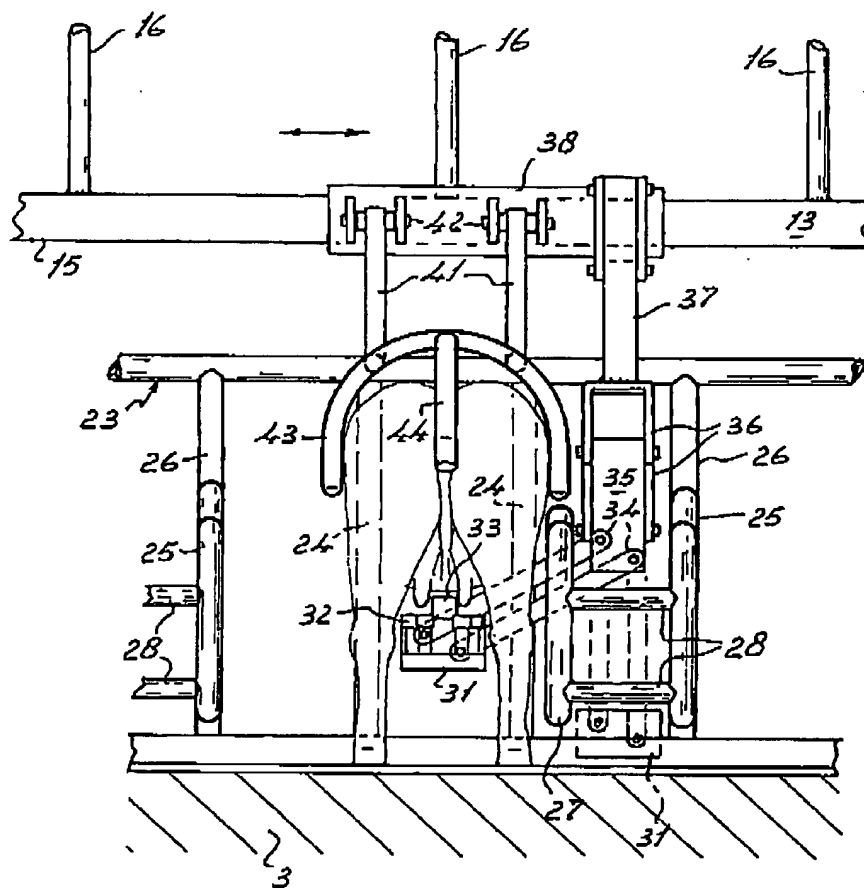
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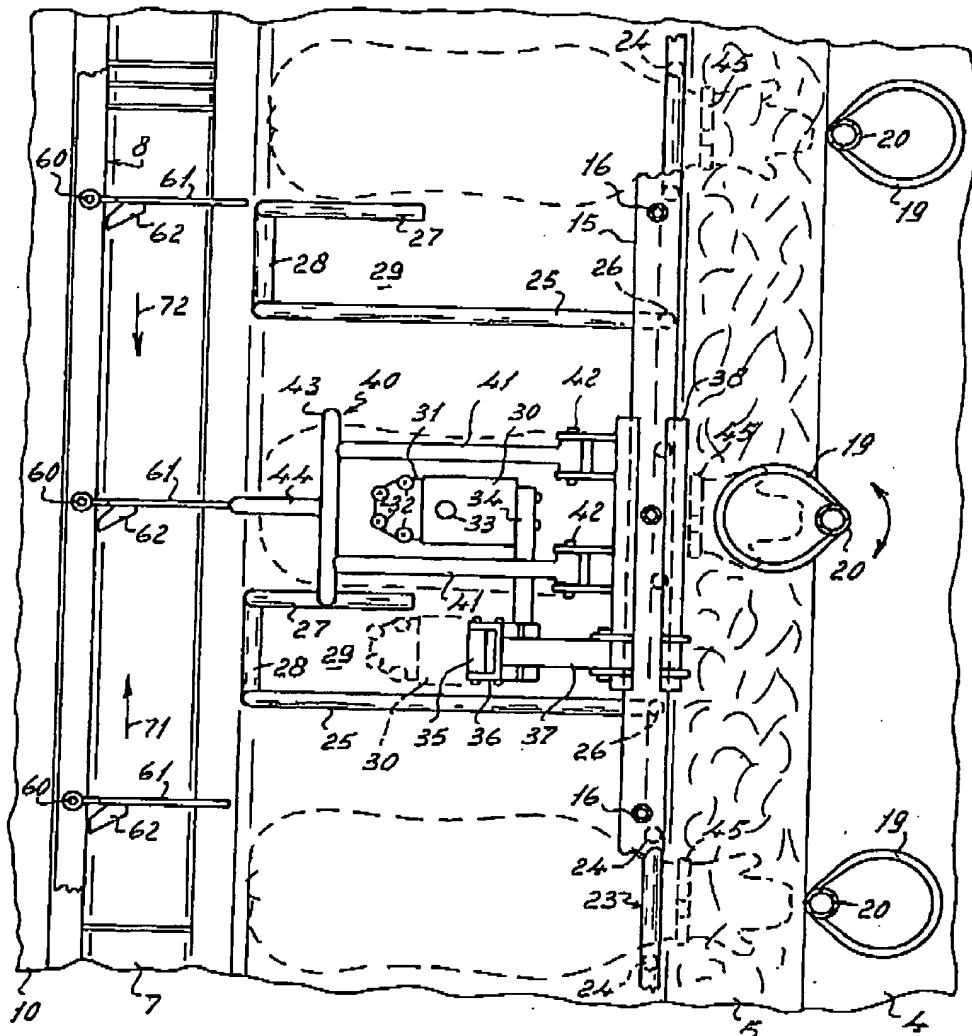


Fig. 5

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